U.S. DEPARTMENT OF THE INTERIOR
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BUREAU OF RECLAMATION AND U.S. FISH AND WILDLIFE SERVICE

WATER-RESOURCES INVESTIGATIONS REPORT 00–4065
Stanton, J.S. 2000, Areas of gain and loss along the Platte River, central Nebraska, spring 1999

INTRODUCTION

In an effort to protect endangered and other wildlife species, the governors of Nebraska, Colorado, and Wyoming, and the Secretary of the Interior signed an agreement in 1997 (Platte River Endangered Species Partnership, 1997) to initiate the development of a basin-wide habitat recovery program for the central reaches of the Platte River in Nebraska. This agreement recognizes the need to maintain minimal flows in the central reaches of the Platte River. An understanding of the surface-water and ground-water interaction along the central reaches of the Platte River is critical to deliver water to the targeted habitat areas. Therefore, a study by the U.S. Geological Survey (USGS), in cooperation with the Bureau of Reclamation and U.S. Fish and Wildlife Service, was conducted to determine qualitatively the areas of gain and loss along the central Platte River between Gothenburg and Silver Creek, Nebraska (fig. 1). The purpose of this report is to present the results of the study.

APPROACH

Central Platte and Tri-Basin Natural Resources District (NRD) personnel measured water levels in 259 irrigation and observation wells between the middle of April and the beginning of May 1999. Between May 25 and 27, 1999, USGS personnel measured surface-water levels at 35 locations along the Platte River and ground-water levels in 77 irrigation wells. All water levels were measured in the central Platte River area, which includes parts of Adams, Buffalo, Dawson, Gosper, Hall, Hamilton, Kearney, Merrick, Phelps, and Polk Counties in Nebraska (fig. 1).

Water levels were measured when little widespread rainfall had occurred and river discharge was believed to be affected minimally by upstream rain events. Because the water table is relatively flat in this part of the Platte River Valley, high streamflow events may reverse the gradient between surface water and ground water that is present during base-flow conditions. The measurements also were made during the spring when pumping and evapotranspiration were considered minimal.

At the 371 surface-water and ground-water sites, Nebraska Natural Resources Commission personnel used differential Global Positioning System (GPS) surveying to determine the site locations and land-surface altitudes to the nearest 0.1 foot. All ground-water-level measurements from these sites were converted from depth below land surface to altitude above sea level and contoured using a 20-foot interval to create a generalized water-table configuration map (fig. 1). Continuity of the water table from the river valley to beneath the adjacent uplands is uncertain. Therefore, water-table contours are estimated (shown as dashes) where they are outside the river valley.

AREAS OF GAIN AND LOSS

The water-table map shows that the central Platte River was not exclusively gaining or losing (fig. 2) in spring 1999. Dashed arrows are drawn perpendicular to the water-table contours, indicating the direction of ground-water flow. Areas of gain were where the general direction of ground-water flow (dashed arrow) was toward the river, and areas of loss were where the general direction of ground-water flow (dashed arrow) was away from the river.

In the western part of the study area, water-level contours showed that ground water was moving towards the Platte River. Because ground-water flow lines generally converged toward the Platte River in this part of the valley, the river was considered gaining. This condition is illustrated in hydrologic section A-A′ (fig. 3).

East of Kearney, the ground-water flow was essentially parallel to the river in an area of neither gain nor loss. In Hall County is an area of loss where ground-water flow is slightly away from the river.

Near Grand Island, water levels indicated that the river may have been slightly gaining from ground water on its north side and slightly losing to ground water on its south side. These conditions are illustrated in hydrologic sections B-B′ and C-C′ (figs. 4 and 5). However, without thorough investigation of the hydrogeology in this area, it is not certain that water levels measured in wells on the uplands south of the river represent a continuous extension of the water table from the Platte River Valley.

In eastern Merrick County and Polk County, the direction of ground-water flow resumed a pattern similar to the western part of the study area and the river was again gaining from ground water.

ACKNOWLEDGMENTS

The author appreciates the assistance of the Central Platte and Tri-Basin NRDs for providing ground-water-level measurements. Special thanks are extended to the Nebraska Natural Resources Commission for sharing their expertise in and information from high-accuracy GPS methods. Appreciation also is extended to Sonja Sebree of the USGS for her help with Geographic Information Systems (GIS).

REFERENCES

Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, Ground water and surface water—A single resource: U.S. Geological Survey Circular 1139, 79 p.

Platte River Endangered Species Partnership, 1997, Cooperative agreement for Platte River research and other efforts relating to endangered species habitat along the central Platte River, Nebraska: accessed April 5, 2000, at URL http://www.platteriver.org/library/CA6.5.htm

Sea level: In this report, the "sea level" datum for land-surface information refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called the Sea Level Datum of 1929; the "sea level" datum for GPS-derived water-level information refers to the North American Vertical Datum of 1988 (NAVD of 1988)—a mathematical least squares general adjustment of the vertical control part of the National Geodetic Reference System.

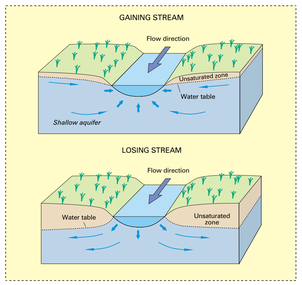

Figure 2. Conceptual model of ground-water movement in alluvial systems (from Winter and others, 1998).

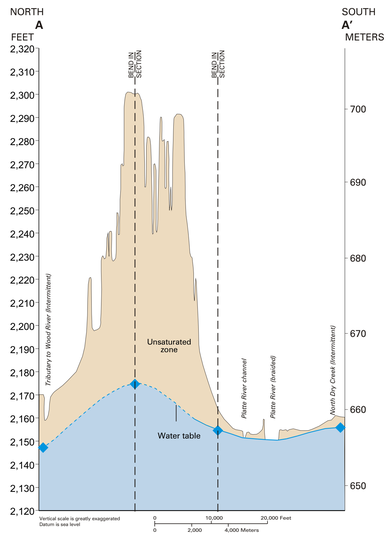

Figure 3. Generalized hydrologic section A-A′, near Kearney, spring 1999. Trace of section shown in figure 1.

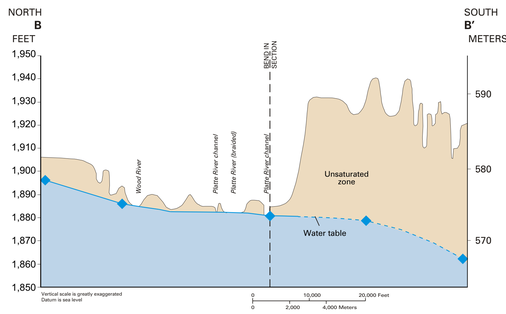

Figure 4. Generalized hydrologic section B-B′, west of Grand Island, spring 1999. Trace of section shown in figure 1.

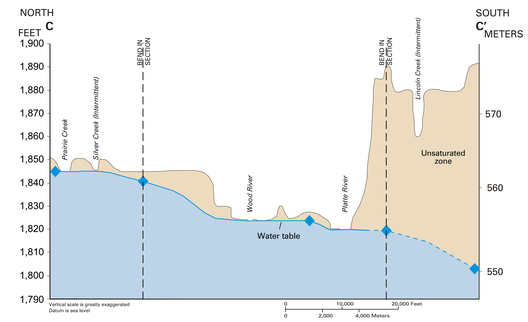

Figure 5. Generalized hydrologic section C-C′, east of Grand Island, spring 1999. Trace of section shown in figure 1.

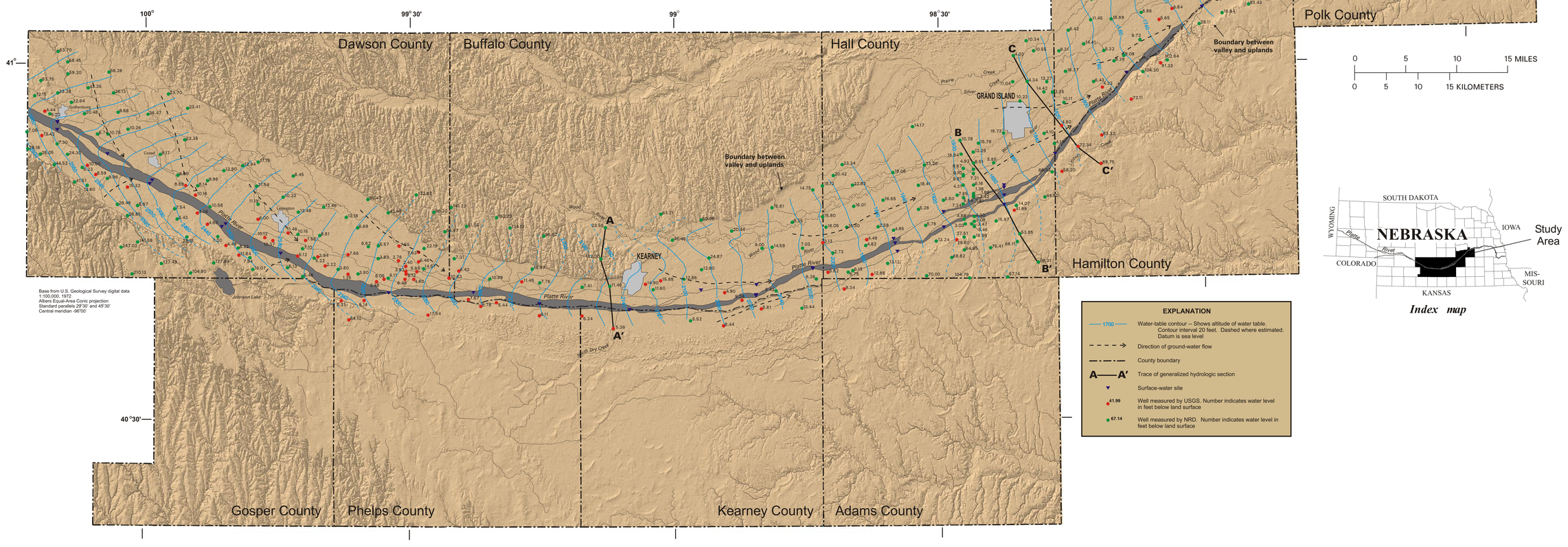

Figure 1. Generalized water-table configuration and direction of ground-water flow, central Nebraska, spring 1999.

EXPLANATION

Water table. Dashed where estimated

Measurement point

Areas of Gain and Loss Along the Platte River, Central Nebraska, Spring 1999

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